

# PATENT SPECIFICATION (11)

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DRAWINGS ATTACHED

(19)

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## (54) SUPERCONDUCTING ELECTRICAL MACHINE ROTORS

(71) We, INTERNATIONAL RESEARCH & DEVELOPMENT COMPANY LIMITED, a British Company, of Fossway, Newcastle-upon-Tyne NE6 2YD, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to superconducting electrical machine rotors.

In our co-pending British Patent Application No. 29436/69 (Serial No. 1,315,302) we describe a superconducting electrical machine in which the rotor winding is formed of superconducting material and cooling means are provided to reduce the temperature of the winding to a temperature at which the material becomes superconducting typically 4-6° Kelvin. With such rotors the need for a magnetic core is obviated and the object of the present invention is to provide a rotor construction suitable for such machines.

In accordance with the present invention a superconducting electrical machine rotor construction comprises a generally cylindrical assembly of flat coils of varying width lying in chordal planes of the assembly, each coil being composed of superconducting material and being wound around a former of electrically insulating material, the individual coils being electrically insulated from one another, and the coils being bound together by layers of electrically insulating material.

The formers for the coils can be of reinforced synthetic resin, preferably using woven glass fibre sheet as the reinforcement. The layers of insulating material binding the coils together can be of resin-bonded carbon fibres.

The invention will be described in more detail with the aid of an example illustrated in the drawing accompanying the provisional specification, in which:—

Figure 1 is a section through one end of a rotor construction in accordance with the invention,

Figure 2a is a half-section on line A-A of Figure 1, and

Figure 2b is a half-section on line B-B of Figure 1.

The rotor construction shown in the drawing is a rotor carrying a direct-current superconducting field winding for use in an alternating current generator having a stationary non-superconducting armature winding. It comprises a generally cylindrical assembly of flat coils 1 of varying width which in this embodiment are generally rectangular. The coil sides running parallel to the axis of the rotor will generally be straight and parallel but the shapes of the ends of the coils could be, for example, semi-circular or oval. The coils 1 lie in chordal planes of the cylindrical assembly, as can be clearly seen in the cross-section of Figure 2b. The coils are wound around formers 2 of electrical insulating material composed of synthetic resin reinforced with woven glass fibre sheet. They are bound to the formers by electrical insulation 3 which may be resin-bonded, carbon fibre material.

The individually insulated coils and their formers are then assembled by placing together the two widest coils 1a, 1b and wrapping layers of further insulation 4 around them. The insulation 4 may also be of resin-bonded, carbon fibre material.

After the first pair of coils have been wrapped two more coils 1c and 1d are added and further layers of insulation 4 applied. The process then continues with successive pairs 1e, 1f, 1g, 1h, 1k and 1l added and surrounded by further layers of insulation. The insulation 4 is arranged in successive loops around the assembly as shown.

It will be seen that the conductors forming the coils 1a, 1b are wider in cross-section than the conductors of succeeding coils. This variation of conductor width whilst not essential is advantageous in machines where it is desirable to have a sinusoidal flux distribution. The use of conductors of varying width means that the centrifugal forces acting vary around the rotor but the layers of insulation 4 are thickest where the conductors are widest i.e. around conductors 1a and 1b.

The thickness of each layer of insulation 4 can also be varied to suit support requirements at various sections of the winding. Where carbon fibre reinforced materials are

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used the forces acting are taken up as tension in the fibres.

At the ends of the rotor the insulation 4 can be built up to a radial depth sufficient to allow a lightly stressed splined joint to be formed with conical rotor end members 5. The end members 5 are integral with the stub shafts which are located in bearings to support the rotor assembly.

The cooling system for the rotor is not shown but takes the form of cooling tubes arranged adjacent the superconducting coils 1 and within the layers of insulation 3 and 4. These cooling tubes communicate at the ends of the winding with ducts disposed on the inner face of the rotor conical end members through which cryogenic fluid is supplied to the cooling tubes to cool the superconducting winding.

#### WHAT WE CLAIM IS:—

1. A superconducting electrical machine rotor construction comprising a generally cylindrical assembly of flat coils of varying width lying in chordal planes of the assembly, each coil being composed of superconducting material and being wound around a former of electrically insulating material, the individual coils being electrically insulated from one another, and the coils being bound

together by layers of electrically insulating material.

2. A rotor construction as claimed in claim 1 in which the formers are of reinforced synthetic resin.

3. A rotor construction as claimed in claim 2 in which the synthetic resin is reinforced with woven glass fibre sheet.

4. A rotor construction as claimed in claim 1, 2, or 3 in which the material binding the coils together is reinforced synthetic resin.

5. A rotor construction as claimed in claim 4 in which the binding material is synthetic resin reinforced with carbon fibres.

6. A rotor construction as claimed in any of claims 1 to 5 in which the ends of the cylindrical assembly are joined to hollow conical end members which are integral with stub shafts for the support of the assembly.

7. A rotor construction as claimed in any of claims 1 to 6 in which the width of cross-section of the conductors of the coils varies around the periphery of the rotor.

8. A superconducting electrical machine rotor construction substantially as described with reference to the drawing accompanying the provisional specification.

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FIG. 1

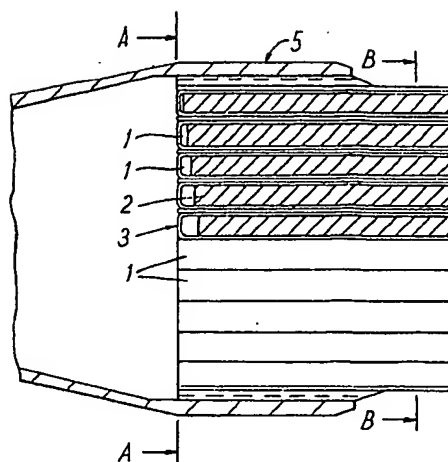


FIG. 2b

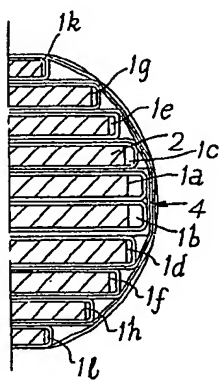


FIG. 2a

